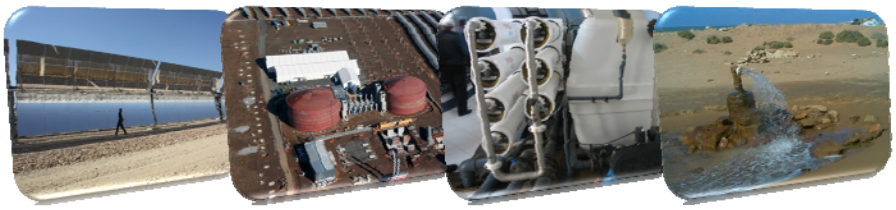


MED CSD

Combined Solar Power and Desalination Plants:
Techno-economic potential in Mediterranean Partner Countries

Renewable Energy Scenarios

Dr. Franz Trieb

DLR Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

Training Worskhop
RABAT, 17 MAY 2010

Portfolio of Energy Sources for Electricity

- ✓ Coal, Lignite
- ✓ Oil, Gas
- ✓ Nuclear Fission, Fusion

ideally stored primary energy

- ✓ Concentrating Solar Power (CSP)
- ✓ Geothermal Power (Hot Dry Rock)
- ✓ Biomass
- ✓ Hydropower

storable primary energy

- ✓ Wind Power
- ✓ Photovoltaic
- ✓ Wave / Tidal

fluctuating primary energy

Criteria for Sustainable Electricity Supply

✓ **Inexpensive**
- low cost
- no long term subsidies

✓ **Secure**
- diversified and redundant supply
- power on demand
- inexhaustible resources
- available technology

✓ **Compatible**
- low pollution
- climate protection
- low risks for health and environment
- fair access

Renewable Energy Technologies


Hydropower


Concentrating Solar Power


Biomass


Geothermal


Tides

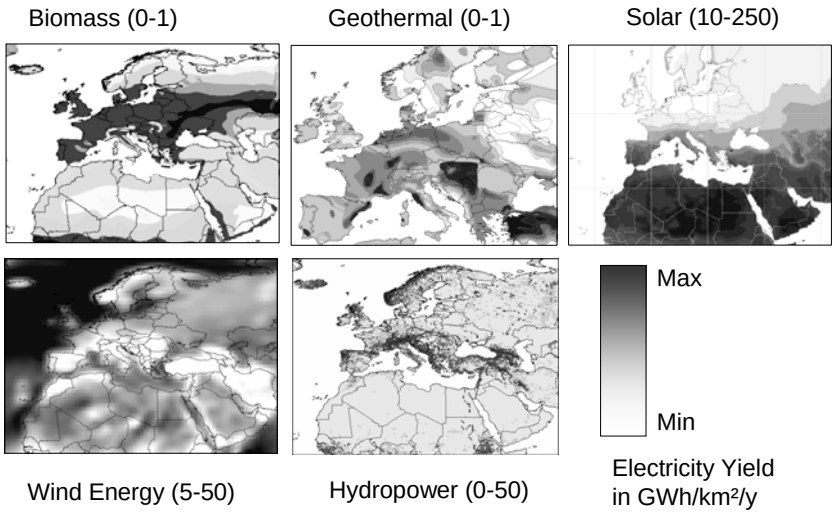

Waves


Photovoltaic

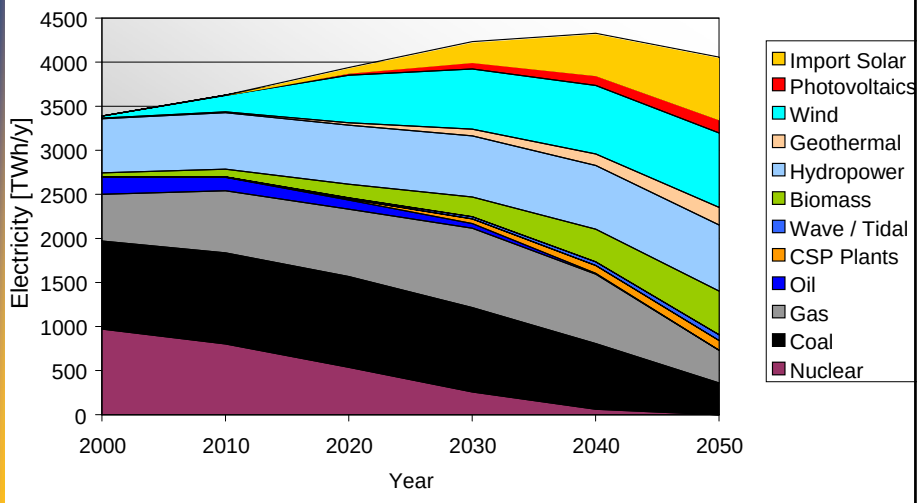

Wind Power

http://www.erneuerbare-energien.de/inhalt/36983/35338/

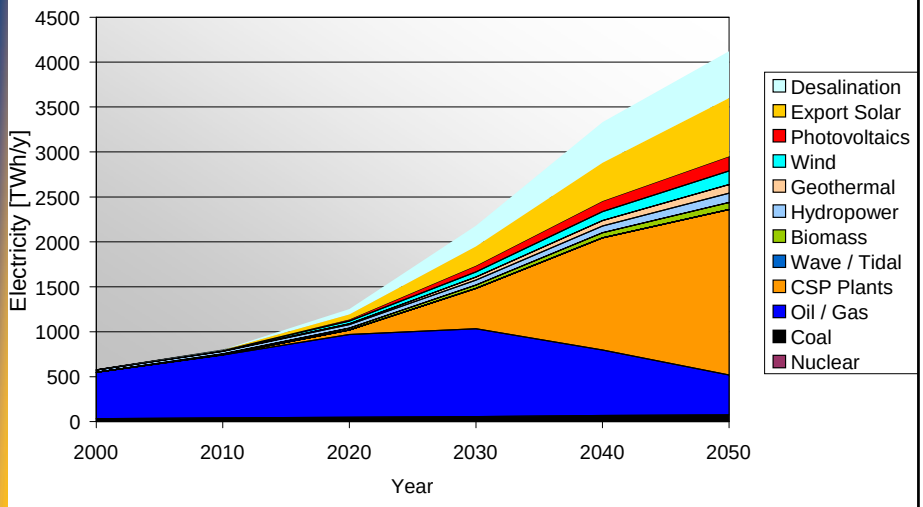
Renewable Electricity Potential in Europe, Middle East & North Africa



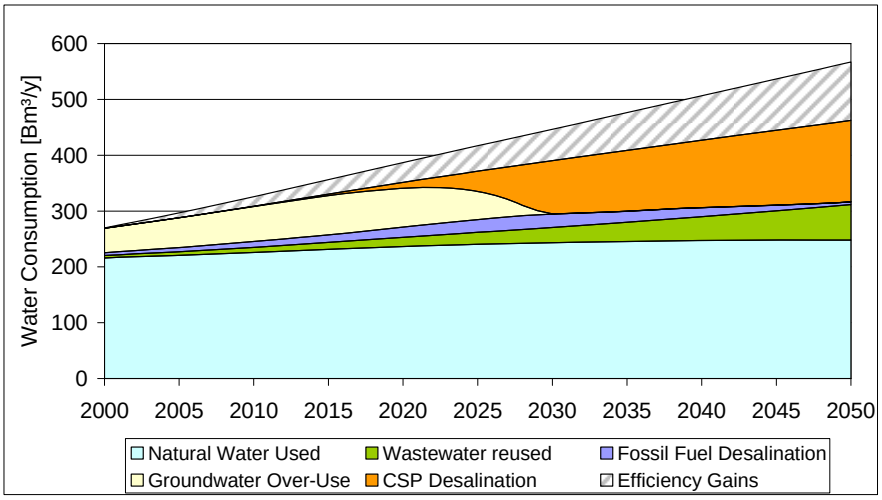
Electricity Supply in Europe



Electricity Supply in the Middle East & North Africa



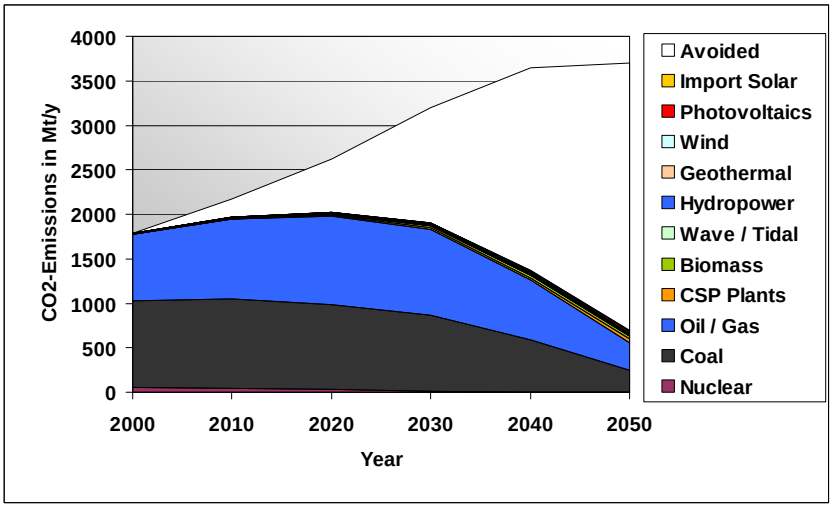
Water Supply in the Middle East & North Africa



Availability and Redundancy

- Power on Demand by a Mix of Fluctuating and Balancing Sources
- Increased Number of Non-Correlated Energy Sources
- Increased Number and Reduced Average Size of Power Plants
- Increased Number of Supply Regions
- Additional HVDC Grid Infrastructure for Long-Distance Transfer
- Domestic Sources Dominate the Electricity Mix
- Renewable Sources Dominate the Electricity Mix
- Strategy Based on Proven Technologies

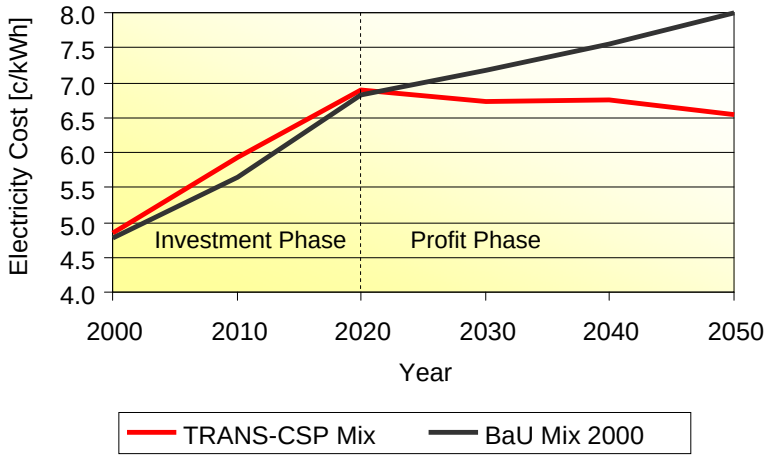
Carbon emissions of EUMENA power sector are reduced to 38 % until 2050 in spite of a quickly growing demand



Environmental Security

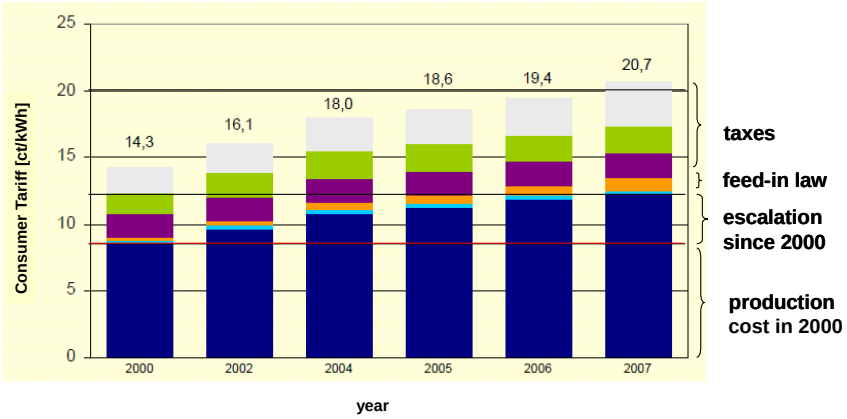
- **Reduced Life Cycle Greenhouse Gas Emissions**
- **Reduced Risks from Nuclear Radiation and Proliferation**
- **Reduced Pollution by Combustion Products**
- **Optimal Land Use (1%) through Diversified Mix**
- **Technology based on Recyclable Materials**

Electricity Cost (Example Spain)



€$_{2000}$, Fuel Cost: IEA / WEO 2005, after 2020 CCS

German Feed-In Law: Impact on Consumers

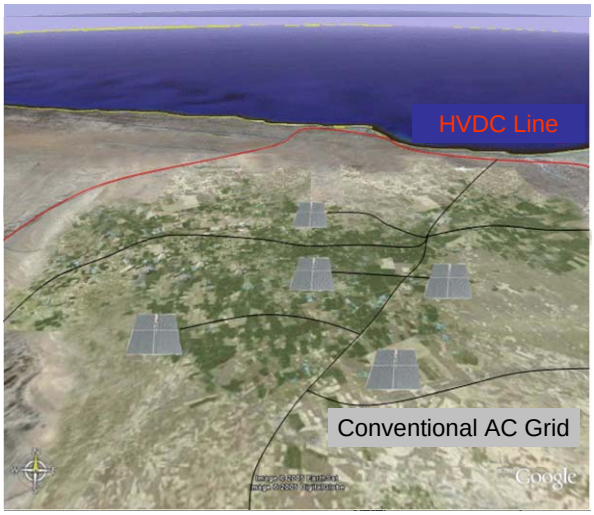


Feed-In Law 2007: 1.0 ct added but 0.5 ct escalation avoided

Economic Security

- Economic Risk Hedged by Increased Portfolio
- Intrinsic Trend to Lower Cost and Lower Price Volatility
- Energy Cost Stabilization through Investment in New Sources
- Avoids Cost Escalation from Environmental Constraints
- Avoids Cost Escalation from Scarcity
- Reduction of Energy Subsidies

Solar Power & Desalination Plants



Energy,
Water,
Food,
Labor and
Income

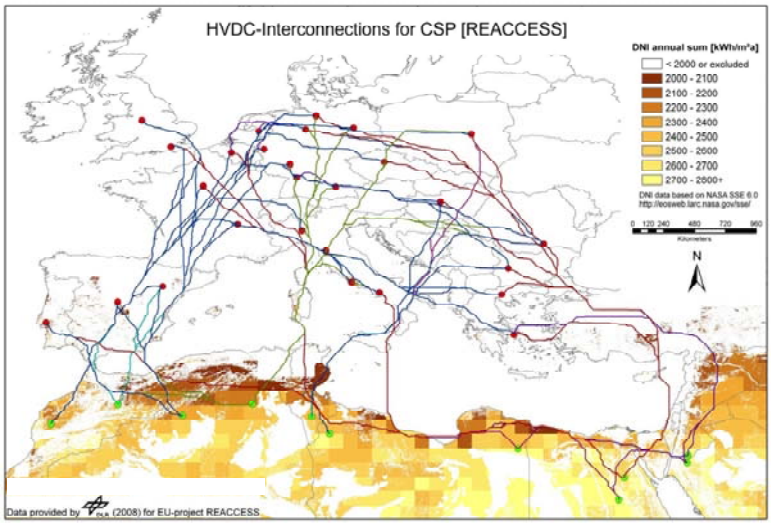
for further
300 Million
People
in MENA ?

(artist view created with Google Earth)

Political Security

- **Conflict Prevention by Reducing Pressure on Fuels**
- **Conflict Prevention Solving Energy and Water Scarcity**
- **Conflict Prevention Increasing Energy Diversity**
- **Reduction of Energy Import Dependency**
- **Addition of Energy Corridors for Sustainable Supply**
- **Initiating EU-MENA (Energy) Partnership**

Solar Electricity Corridors from MENA to Europe



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www.dlr.de/tt/csp-resources

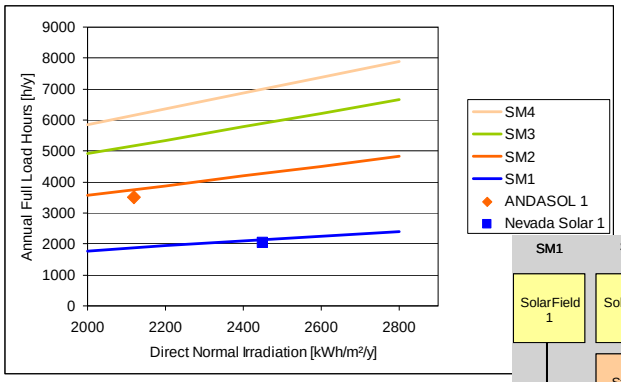
High Voltage Direct Current Transmission in China

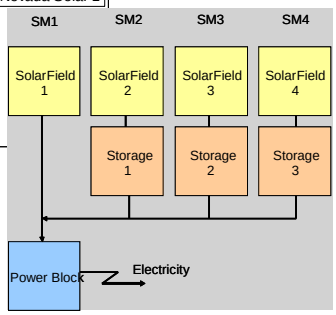
Voltage:	± 800.000 Volt
Power:	6400 Megawatt
Length:	2070 km
Source:	Hydropower
Losses:	7%

MED CSD

http://www.abb.com
http://www.siemens.com

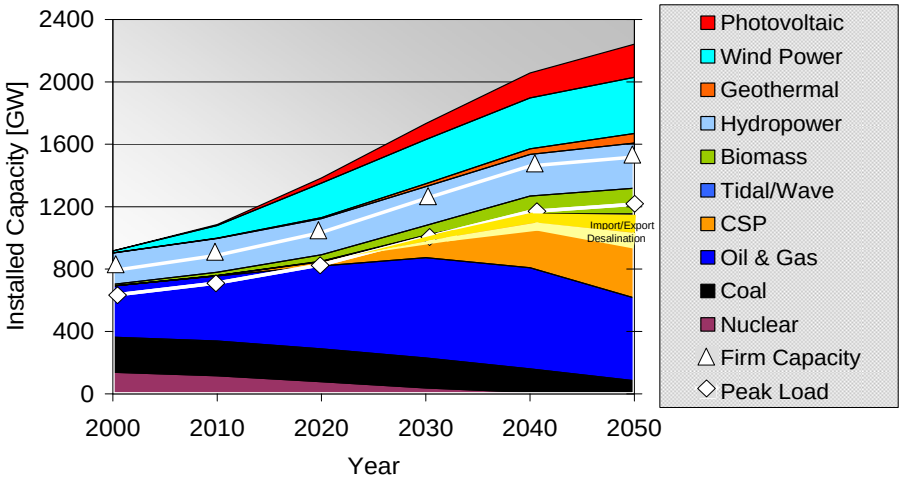
Effect of Thermal Energy Storage on the Availability of CSP





SM = Solar Multiple
1 Solar Field = 6000 m²/MW
1 Storage = 6 hours (full load)

Installed Capacity vs. Peak Load in EUMENA



Challenges

- **Requires New Structures and New Thinking (Change of Paradigm)**
- **Requires Long-Term Financing Scheme for Large Infrastructure**
- **Based on International Cooperation and Interdependencies**
- **Higher Complexity than Using Ideally Stored Fossil Energy Sources**
- **More Stakeholders Involved due to Decentralized Generation**
- **Cultural and Political Differences in EUMENA**
- **Lobby Groups Acting Against Each Other**
- **Speed of Environmental Change and Conflict Potentials**

WHY POWER FROM THE DESERT ?

Potential:
3.000.000 TWh/a — 18.000 TWh/a Global Demand

Land Use:
150-300 m²/GWh — 400 m²/GWh Coal
800 m²/GWh „Clean“ Coal

Availability:
7.500 h/a — 7.500 h/a Nuclear Plant

WHY NOT ?

Fthenakis and Hyung 2009, own calculations

Thank you

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www.med-csd-ec.eu